ASTRO-GEOGRAPHY IN THE GRADES.

THE writer of this paper is prepared to hear the reader promptly object to its high-sounding caption. Astro-geography to be seriously considered as a subject for study in the grades! Then he imagines he hears the mental shock relieved with the remark: "Well, I suppose he wanted to write an article for a magazine, and he must have a novel title at least."

But let us pursue the matter a little farther. Is the title so malapropos as it seems on first thought? The reader will hardly deny us the favor of reading far enough into our paper to find out at least what is meant by its title. What meaning can there be in the phrase "Astro-geography in the grades"?

Let me begin the answer to this question in the good old Yankee fashion of asking another. What is the meaning of "geography in the grades"? Are we seeking to secure only the informational value to the pupil of a body of more or less disjointed facts for his possible future use as a guide in travel, in raising crops, or in judging whether when he starts on a walk he would better take his umbrella along? Or should the geography teacher rather be seeking to establish points of contact between the life of the pupil and the laws of such natural phenomena as hem him in and are capable of being set into orderly array by him? Have we gone so far in our pedagogical rage to harmonize the successive appearance of the mental faculties with the several grades of our artificial school system as to deny to the student below the age of ten the possession of rational faculties even in a weak degree? If so, the sooner we stop theorizing and look at the child, the better for our pedagogy. Some would have us believe that it is not until after the much-talked-of adolescent period that the student really begins his rational existence. This paper proceeds upon the view that a pedagogy based upon the study of segments of child-life made between *transverse* sections is a poor pedagogy. It assumes the gradual growth and decay of the mental powers in the individual from the first day of existence

to the last. In other words, it is held that, if we must treat the life of the learner by sections, the *longitudinal* section reveals a truer state of things for the teacher.

Too much is often made of observation as an end in itself. Evidence has long been sufficiently plentiful that the training of the observing faculties is impossible without due regard to the necessity of interpreting the meaning of the observations. Most of us fall short, not in failing to observe, but in failing to observe intelligently. Observations uninterpreted are always blind and pointless. It is no less true of children than of adults that observation, to be educative, must be rational. The emphasis of this paper is, accordingly, that especial attention be given to having the children draw their own inferences from their observations. The sort of work called for below will be valuable only in the degree in which it trains pupils both to observe and to reason on their observations.

To give the pupil the proper foundation of ideas on which to erect his edifice of geographical knowledge, it is necessary that he be led very early to grapple with some pretty broad conceptions. His home region is, of course, his starting-point, and only his starting-point, in the formation of his conceptions. To confine his geographical knowledge too long to his direct experiences in his home region is to shorten his perspective and to render difficult his conception of the earth as a whole. He must very soon leave the local environment and launch out upon the broad expanse of the vastly greater part of the earth's surface which he can never expect to see directly, but which his local experiences enable him to see with "his mind's eye." In other words, the conception of the earth as a whole, and even the more difficult conception of the earth as a member of the planetary system, should be introduced very early into the study of elementary geography. The gradual transition from local and necessarily short-sighted notions of the appearances of near objects on the earth can be easily made by directing the pupil's observation to the appearances of remote objects and of the landscape from sky-line to sky-line, and thence to the appearance of the moon and of the sun. The interpretation of these appearances must needs

be assisted by the aid of globes illuminated under various conditions in the schoolroom. No better work can be done by a very elementary geography class than to spend enough time observing the appearance of the moon and its position from evening to evening among the stars, to trace the obvious changes through an entire lunation. Crude sketches of the phases, and light and dark shadings, of the lunar face, including two or three of the brighter neighboring stars, can be made by very young pupils with very little assistance, by merely directing their attention successively to the desired features. The writer has seen a group of ten-year-olds enthusiastically engaged in such work on the moon, and in similar work on Venus, from evening to evening, during the summer months for two weeks. They were veritable little astronomers, investigating at first-hand phenomena which would have made many an adult scientist blush for his lack of interest and intelligence in such matters. One could easily imagine the exultance of spirit with which they seized upon the discoveries brought out by the comparison of their crude little working sketches from night to night, as not unlike that "divine intoxication" with which the great astronomers of the past have trembled as they approached the sacred presence of new discoveries. Who that has seen the enthusiasm of these embryo scientists can doubt the educational genuineness of the effort thus put forth? The difficulty in doing such work in the schools is either imaginary or is due to the mental passivity into which teachers have trained themselves by long-continued ignoring of the great truths which lie under their immediate ken. The freshness of spirit and open-mindedness to truth of the boys and girls who have not yet learned how to conceal or stifle their enthusiasm at the first-hand discovery of new truth will be both a revelation and in some instances a mortification to grown-up folk.

By the aid of a couple of sticks and the law of simple proportion — which law may be better taught in this way than is done in the texts — the pupil may measure for himself the actual diameter of the moon, if the teacher will give him its distance. For a simple form of solution of this problem the teacher is referred to the *Rational Grammar School Arithmetic.* (Problem

17, p. 199.) When the pupil has found from his own measures that the diameter of the moon is over two thousand miles, that it looks round, and is visibly spotted with light and dark shadings, it is much easier for him to form an adequate conception of an earth eight thousand miles in diameter, spotted over with seas and continents. An opera glass will aid materially in impressing the student with the roundness of the lunar globe and with the spottedness of its surface.

Again, after the pupil has followed from evening to evening, or at intervals of only a few evenings, the slow eastward creeping of the moon among the stars, pretty well through a complete lunation, he will have picked up many ideas incidentally which will later be most valuable to him in his work in geography and in nature study, and which will afford him a source of genuine pleasure all his life. He will, if the cause of the observed changes of phase is cleared up for him by the aid of an illuminated globe and an artificial sun, never fall into the popular confusion as to whether the horns of the moon should point from or toward the sun, as to whether the new moon rises in the east or in the west, and as to the meaning of "the old moon in the new moon's arms." If such study is followed at intervals throughout a year, the pupil will learn much about the path of the moon through the stars; will become impressed with the reality of the movements of heavenly bodies — among them the earth; will learn something about the constellations; and under an intelligent teacher may learn to recognize for himself the principal planets both by their appearance and by their visible movements, and may fix in mind the slow westward drift, with the seasons, of the rising constellations. This much observational work on the moon is both feasible and immensely important for pupils from Grades IV to VIII. The only practical difficulty is in getting teachers who feel its importance sufficiently to keep it up systematically without overworking it at any point along the specified interval.

It will at once be objected, even by those who admit the importance of this work, that pupils cannot be gotten to do the observing; that classes of pupils of this age cannot be brought together under the open evening sky with their teachers; and

that the observational work without the teacher would be little better than worthless. These are the staple objections that one always hears. They are nevertheless not valid, even if they have become classical among elementary teachers. Ten or fifteen minutes is enough time for the pupil to give to this observational work for one evening. The more the pupil does without assistance the better. A line or two from the teacher to the parents, directing them as to what observation is wanted, will in most cases secure all the co-operation the teacher needs. The kind of observation, however, which is most valuable, and in which the student should be trained, is independent observation. Very much assistance from the parents is positively harmful. The pupil will bring his notebook to the class the next day, and his work will be gone over with the same care and consideration as should be bestowed on any of the other assigned work.

Nor is this work new. It is, however, not done so extensively as it ought to be. The testimony of those who have tried it is to the effect that the teacher's idea that it is difficult to teach it, as also the pupil's feeling that the observing is difficult, are entirely dissipated by the first attempts at doing it. Miss Eliza A. Bowen, a pioneer and hearty advocate of the sort of observational work here recommended, has prepared an excellent text for the guidance of high-school classes in such work as this. No better idea of the *spirit* of such work can be given than by recommending all interested to study Miss Bowen's text, *Astronomy by Observation*. For grade classes, of course, the plans of this book must be greatly simplified; but this will offer no special difficulty. The four large maps given in Miss Bowen's book, and her suggestion that constellations be always identified by certain geometrical or other familiar forms, suggested by groupings of a few bright stars within the constellation, are directly pertinent to grade work. The following outline will suggest the subject-matter which can and should be studied by direct observation by pupils from Grades IV or V to VIII.

A few nights (four or five) during fortnightly periods should be spent in making notebook records of observational studies and in discussions upon them of the objects given under each of the

following heads. The teacher will be greatly guided by Miss Bowen's text, published by the American Book Co., which contains the greatest amount of usable material of any elementary book yet in print. Upton's *Star Atlas* will also be found serviceable. It must be remembered that the object of the work is to teach pupils both to observe and to think. One or two constellations an evening is sufficient.

1. Fundamental constellations: (*a*) the Great Bear (large dipper); (*b*) the Lesser Bear (Polaris); (*c*) Queen Cassiopeia's Chair; (*d*) the Lyre (Vega); (*e*) the Northern Crown (Arcturus).

2. The zodiacal constellations of September: (*a*) the Virgin (Spica); (*b*) the Scales; (*c*) the Scorpion (Antares); (*d*) the Archer (little dipper); (*e*) the Goat; (*f*) the Fishes.

3. The Milky Way or Galaxy and solstice: (*a*) its position and place; (*b*) its form; (*c*) its brightness; (*d*) location among stars of winter solstice.

4. The zodiacal constellations of November: (*a*) the Fishes; (*b*) the Ram; (*c*) the Bull; (*d*) the Twins (Castor and Pollux).

5. Other constellations and objects of November sky: (*a*) the great square in Pegasus; (*b*) Andromid and Orion nebulæ; (*c*) visible planets; (*d*) moon; (*e*) location among stars of the vernal equinox.

6. Zodiacal and other constellations of February sky: (*a*) the Goat; (*b*) the Water-Bearer; (*c*) the Fishes; (*d*) the Ram; (*e*) the Bull; (*f*) the Twins; (*g*) the Lion (Regulus).

7. The Galaxy and its principal constellations.

8. The constellations of the April sky.

It is impossible to fix a program rigidly for work upon the planets. They must be "taken as they come." But, leaving the work informal, the following facts may easily be gotten at by a little patience and perseverance:

1. Their difference in appearance from the stars.

2. Their brightness as compared with neighboring bright stars.

3. Their differences of color.

4. Their positions with reference to bright stars, estimated and recorded in direction (north — toward Polaris) and in terms of the distance (5°) between "the pointers."

5. Their paths mapped on small globes suitably provided with parallels of latitude and meridians of longitude.

6. Their movements with respect to the sun.

7. Their appearances in an opera glass described and read up in a simple text (Holden's *Astronomy*).

8. Comparative study of the earth as one of the planets; changes observed on the sky caused by earth's diurnal and annual motions being pointed out.

9. Relations of a planet and sun studied with an illuminated model.
10. Study of pictures of planets with lantern where possible.

Much is made nowadays of fairy-stories and classical myths in the elementary schools. Some of the finest mythology ever produced centers around the constellations. Literary references to these myths are frequent. Often have they been made "to point a moral or adorn a tale." Why not make much more of these myths with the very early grades than we do? In addition to their intrinsic beauty, these classical myths have a historical value and will become a permanently useful possession to the children. Let us make more of them!

In the later grades the observational work should become more distinctively *quantitative* in character. Such measurements as are set forth in the pamphlet given at the head of the list of references below may be used to correlate with the grade geometry. Work on the sun such as is outlined in Jackman's *Number Work in Nature Study* should also be made a feature of the seventh- and eighth-grade work.

The list of references here added will serve to put the reader in touch with what has been and is being done along the lines here outlined:

REFERENCE BOOKS.

1. G. W. Myers, *Elementary Experiments in Observational Astronomy.* Chicago: School Science Press.
2. W. S. Jackman, *Number Work in Nature Study.* Chicago: Flanagan
3. Mary Proctor, *Stories of Starland.* Potter & Putnam Co.
4. R. S. Ball, *Starland.* Ginn & Co.
5. E. S. Holden, *The Family of the Sun.* D. Appleton.
6. Parker, *Familiar Talks on Astronomy.* A. C. McClurg & Co.
7. Young, *Uranography.* Ginn & Co.
8. Young, *Lessons in Astronomy.* Ginn & Co.
9. Eliza A. Bowen, *Astronomy by Observation.* American Book Co.
10. Gregory, *The Planet Earth.* Macmillan & Co.
11. Durham, *Astronomy, Sun, Moon and Stars.* Adam & Charles Block.
12. Winslow Upton, *Stars Atlas.* Ginn & Co.
13. E. P. Jackson, *Astronomical Geography.* D. C. Heath & Co.
14. E. R. E. Cowell, *Curiosities of Latitude and Longitude.* Chicago: Thos. Charles & Co.

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